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(54) GAP SENSING/ADJUSTMENT APPARATUS AND METHOD FOR A LITHOGRAPHY MACHINE.

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SOLID STATE TECHNOLOGY, September 1986, John H. McCoy and Paul A. Sullivan, pages 59-64, Figures 1.8

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Description

This invention relates to apparatus and a method for maintaining the mask to wafer gap constant in a X-ray lithography machine, and more particularly, for adjusting the plane of the wafer on a section by section basis so as to compensate for non-planar variations of the wafer.

For many years, semiconductor chips have been fabricated utilizing an ultraviolet light lithography machine to expose a pattern on a photoresist covered wafer. Typical state-of-the-art commercial wafers have a diameter of between three and eight inches. Since the area of the wafer which desirably can be reliably exposed at any given time is substantially less than the size of the wafer, the wafer is moved in incremental steps across an exposure area. typically during each step, the same pattern of light, defined by a mask or reticle, is applied to and exposes a photoresist layer covering the wafer. After the entire wafer has been moved in incremental steps past the exposure area, each section of the wafer will have been identically exposed. An example of such a step and repeat photolithography system is described in United States Patent 4,444,492 in the name of Martin E. Lee. Apparatus similar to the step and repeat photolithography system described in the aforementioned Lee patent has been incorporated in the commercial products sold by Ultratech Stepper Corppration in its models 900 and 1000.

Historically, the requirements on the semiconductor industry has been to fabricate smaller and smaller features on each chip, so that correspondingly more and more semiconductor devices can be placed on each chip. Recently, the feature size being fabricated has reached the limits of conventional ultraviolet photolithography machines. More specifically, the size of features which can be placed on a semiconductor wafer is limited by the wavelength of the energy used to expose the resist. In the case of ultraviolet light, this limit is approximately one micron in size. In order to fabricate semiconductors devices with feature sizes of less than one micron, and still have acceptable yields, it is necessary to utilize an energy source with a wavelength shorter than ultraviolet light. Soft X-rays appears to be the best candidate for such a source.

When fabricating features of less than one micron on a semiconductor wafer, other problems are also created. These other problems include the registration and alignment accuracy requirements placed upon the stepper stage carrying the wafer from position to position beneath the exposure area. It is not sufficient to merely reduce the size of each of the steps of the stepper stage in order to increase the accuracy. As the features become smaller and smaller, other considerations must be taken into account, such as the unevenness of the wafer surface itself. For example, see Underhill et al "Wafer flatness as a contributor to defocus and to submicron image tolerance in step-an-repeat photolithography", J. Vac. Sci. Technol. B5(1), (Jan/Feb 1987). In certain types of X-ray lithography systems, such as the type originally described by Nagel et al in U.S. Patent 4,184,078 and further described by Forsyth et al in U.S. Patents 4,692,934 and 4,700,371, the gap distance between the X-ray mask and the resist covered surface of the water is critical to proper operation. With respect to this gap distance, it is desirable to have each section of the wafer, when being exposed, evenly spaced from the mask over the entire exposure area. In other words, it is necessary to maintain the plane of the exposure side of the wafer parallel with the plane of the mask.

Other registration and alignment problems also must be solved when fabricating submicron images on semiconductor wafers. Many of these problems relate to the mechanical structure of the step and repeat mechanism itself. All step and repeat mechanisms must be capable of moving the wafer with six different degrees of freedom. These are linear movements in the X, Y, and Z directions, as well as tip, tilt and theta rotational motions about each of these axis. As used herein, "tip" means rotation about the x-axis direction, "tilt" means rotation about the y-axis direction, and "theta" refers to rotation about the z-axis direction.

In the past, the controlling mechanisms for moving the wafer in the various degrees of freedom have been positioned without considering the effect that movement in one degree has on the overall position, registration and alignment of a particular section of the wafer. For example, precise X and Y distances and hence position, can be measured utilising an interferometer device. In the past, the interferometer has been mounted on the stepper mechanism well below the plane of the wafer. Thus, any tipping or tilting while adjusting the plane of the wafer, resulted in the slight X or Y error, known as Abbe error, being introduced at the point of exposure. This error was not accurately detected by the interferometer due to its position well below the plane of the wafer.

In accordance with one aspect of this invention, there is provided a stepper system for a lithography machine of the type used to expose a pattern on a resist covered semi-conductor wafer, one section at a time, said stepper system including means for holding said wafer, means for holding a pattern defining mask in a given plane, means for moving said wafer holding means past said mask in integral steps, such that one section at a time of said wafer becomes aligned with said mask, and means for directing energy through said mask to expose said pattern on said aligned section of said wafer, characterised by means for determining a section plane of each section of said wafer relative to said given plane by detecting at least three

different points in each section; and means, in response to said means for determining, for adjusting the plane of said wafer, as each section of said wafer becomes aligned with said mask, to cause that aligned section to be in a desired relationship to said given plane.

One preferred embodiment of the subject invention is hereafter described, with specific reference being made to the following Figures, in which:

Figure 1 is a diagram, particularly in cut-a-way, of an X-ray lithography machine utilizing the step and repeat mechanism of the subject invention;

Figure 2 is a prospective view of the step and repeat mechanism of the subject invention;

Figure 3 is a diagram of the upper portion of the step and repeat mechanism and the lower portion of the exposure column and is useful in understanding the operation of one aspect of the subject invention;

Figure 4 is a view taken across lines 4-4 of Figure 3;

Figure 5 is a view taken across lines 5-5 of Figure 3;

Figure 6 is a semiconductor wafer showing the position of the various exposure sections at which the lithography printing occurs;

Figure 7 is a enlarged view of a semiconductor wafer showing two adjacent exposure sections and illustrating the variations in average planer alignment;

Figure 8 is a flow diagram of an algorythm for the mask leveling function performed by the system shown in Figures 1 and 3;

Figure 9 is a flow diagram of an algorythm for the global leveling and alignment of a wafer performed by the system shown in Figures 1 and 3; and

Figure 10 is a flow diagram of an algorythm for the section by section leveling and exposure of a wafer performed by the system shown in Figures 1 and 3.

Referring now to Figure 1, an X-ray lithography machine 10 is generally shown and includes a high peak power (10 joules) and high repetition rate (one hertz) pulsed laser 12, an X-ray source 14, and a wafer handling mechanism 16 as the principal components of machine 10. Laser 12 provides a laser beam 18 which is directed by mirrors 20 and 22 and focused by lens 24 and finally directed by mirror 26 towards X-ray source 14. Laser beam 18 provided by laser 12 should be powerful enough to cause an X-ray emitting plasma to be formed when beam 18 is focused on a metal target.

X-ray source 14 includes a metal target 20 contained within an evacuated chamber 30. Laser beam 18 is provided through laser beam port 32, which is a part of evacuated chamber 30, and focused by lens 24 to a focal point on target 28. The intensity of laser beam 18 is sufficient to create an X-ray emitting plasma at the focal point on target 28 and the plasma, in turn, emits X- rays 34 into an exposure column 36. The broad concept of source 14 is shown in United States Patent 4,484,339 in the name of Phillip J. Mallozzi et al and the particular structure for target 28 is more fully described in United States Patent Application Serial Number 07/089,496 entitled "Mass Limited Target" in the name of Robert D. Frankel et al, which application is assigned to assignee hereof.

X-ray mask 38, which is positioned at the bottom of exposure column 36, is of a type which blocks certain X-rays 34 and permits the remaining X-rays 34 to pass therethrough, thereby providing a defined pattern of X-rays from the exposure column 36. Mask 38 may be of a type described in United States Patent Application Serial Number 07/039,983 entitled "Compensated X-ray Mask" in the name of Irving Plotnik, which application is assigned to the assignee hereof.

Wafer handling mechanism 16 is of the type in which a semiconductor wafer 40 is held in a chuck 42 and moved in steps so that one exposure section 86 (seen in Figure 6) at a time of wafer 40 is positioned beneath exposure column 36 to be exposed by the pattern of X-rays 34. In fabricating a semiconductor chip, many various series of operations on each exposure section 86 pf wafer 40 are performed. Many of these operations include exposing a pattern on each exposure section 86 of wafer 40 followed by further processing that exposed pattern in a predetermined fashion. Except for the first layer, each pattern is exposed on top of a previously exposed and processed layer of wafer 40. It is extremely important that each new exposure section 86 be properly aligned with respect to the position of proceeding exposure section 86 in order that the fabricated chip operates properly.

In order to preform proper movement and alignment of each section 86 of wafer 40, water handling mechanism 16 must be capable of moving wafer 40 with six degrees of freedom. These six degrees of freedom include three linear directions, that is, the X direction, the Y direction, and the Z direction, and three angular directions. Mechanism 16 rides on a flat granite base 44 and includes a Y stage 46 and an X stage 48. Affixed above and to X stage 48 is a substage 50 upon which the control mechanisms for course Z, and the rotational movements are mounted. In addition, the interferometer mirrors 82 and 84 (shown in Figure 2) are also mounted on substage 50. Substage 50 is affixed to X stage 48 and moves therewith in the X and Y directions.

Y stage 46 moves over granite base 44 in a direction determined by a guide 52 affixed to granite base 44. Guide 52 determines the Y direction and Y stage 46 moves back and forth along guide 52 in that determined direction. Y stage 46 has a guide 54 affixed thereto defining the X direction and X stage 48 moves along guide 54. Substage 50 is positioned above X

stage 48 by three legs 56-1, 56-2 and 56-3, each of which includes a stepper motor assembly 58-1 through 58-3 and a sensor 60-1 through 60-3. The three motor assemblies 58-1 through 58-3 are independently controllable to raise or lower one triangular corner of substage 50 in the Z direction. Each assembly 58-1 through 58-3 shaft is precisely guided by means of flexure pivots (not shown). By moving each of the three motor assemblies 58-1 through 58-3 together, small incremental movements in the Z direction can be obtained. Hereafter, this is referred to as "Fine Z Movement". By moving one or two of the motor assemblies 58-1 through 58-3 individually, the tip and tilt degrees of freedom referred to earlier can be obtained.

Motor assemblies 58-1 through 58-3 are rigidly affixed in a vertical direction from the X stage 48. This causes a slight lateral movement od substage 50, relative to the fixed drive shafts of the motor assemblies 58-1 through 58-3, to occur during the tipping or tilting of substage 50. To permit this lateral movement, the shaft connecting motor assembly 58-1 to substage 50 includes a ball and socket coupling 62 designed to prevent any lateral movement. However, the coupling of the shaft from motor assembly 58-2 to substage 50 is a ball and vee grove coupling 64, designed to permit lateral movement in either the x- or y-direction only, and the coupling of the shaft from motor assembly 58-3 to substage 50 is a ball and flat coupling 66 (seen in Figure 3), designed to allow lateral movement in either of the X or Y directions.

Y stage 46 moves along Y guide 52 by conventional driver means (not shown) in discrete steps and X stage 48 moves along guide 54 by similar conventional drive means (not shown). X stage 48 is held above Y stage 46 by four air bearings 55 extending down from the corners thereof. Air bearings 55 glide along granite base 44 in the direction defined by guide 54. By spacing the four air bearings 55 as far apart as possible, the slight variations in the plane of granite base 44 cause relatively small and repeatable tip and tilt changes in the wafer 40 held by chuck 42. Adjustments to the tip and tilt position of wafer 40 can then be made by the apparatus and techniques hereafter described.

Chuck 42 includes a chuck plate 68 for holding wafer 40 and a motor 70 for moving plate 68 in relatively large vertical increments (course Z). An activator, such as motor, 70 is affixed to the bottom of substage 50 by a flexure 72, such that, as motor 70 operates, the movement is perpendicular to substage 50. Motor 70 may be selected to move wafer chuck 42 upwards from its rest position to a typical displacement of 5 millimeters. A preferred embodiment of motor 70 is an air cylinder, or a solenoid. The fine Z movement is controlled by motor assemblies 58-1 through 58-3, which have incremental steps of 0.12 microns and a maximum range of 400 microns.

In order to properly position wafer 40 with respect to mask 38, a chuck sensor 74 and X-ray chamber sensor 76 are provided, each of which is coupled to the respective chuck 42 and exposure column 36 by respective brackets 78 and 80. The detailed construction of sensor 74 and 76 will be described hereafter with respect to Figure 3 and the operation thereof will be described hereafter with respect to Figures 8 and 10.

The precise X and Y positions of wafer handling mechanism 16 can be determined by a interferometer device. Such a device is well known in the art and includes a light transmitting device (not shown), one of the Y mirror 82 or the X mirror 84, and a light receiving device (not shown). The interferometer device measures the accumulated Doppler shift between transmitted and received light beam and thereby determines very precise displacements. For example, the interferometer devices may measure relative X and Y distances in lithography system 10 in the order of 0.02 micron. The Y mirror 82 and X mirror 84 associated with the two interferometer devices are mounted on substage plate 50 very close to the same height as wafer 40. By mounting mirrors 82 and 84 in this position, any corresponding X and Y lateral movement at the wafer 40 exposure plane due to the tip and tilt adjustment by fine Z motor assemblies 58-1 through 58-3 is monitored by the interferometer.

In addition, there is associated with coarse Z motor 70 means (not shown) for rotating the plate 68 to provide a rotational degree of freedom movement. Such means are well known in the art and are described in the afore-mentioned patent to Lee.

Referring now to Figures 3-7, the detailed manner in which mechanism 16 operates to properly position and align a section of wafer 40 with respect to mask 38 will now be described. Generally, in X-ray lithography systems, such as machine 10, the distance of the gap 39 between the mask 38 and wafer 40 is critical to the proper exposure of the resist layer on water 40. The plasma creating the X-rays within X-ray source 14 is extremely small and considered for purposes herein to be a point source. Thus, the X-rays are emitted in a cone from the point source and those X-rays which pass through the X-ray transmissive portion of mask 38 continue expanding away from the axis of the cone. In order to regulate magnification, the gap 39 distance between mask 38 and wafer 40 should be maintained small and constant.

The size of the features which may be exposed on wafer 40 using an X-ray energy source is 0.5 micron or less in size. With this small feature size, it is necessary that precise alignment be maintained between the wafer 40 and mask 38 and any change in magnification caused by variations in the qap 39 between mask 38 and wafer 40 must be kept to a minimum. For example, if the gap 39 is set to be 20 microns, it should not vary by more than 0.25 microns at any point from

mask 38. With such a small tolerance available for the gap 39 distance, one must consider the flatness of wafer 40 itself.

In using a step and repeat handling mechanism, such as mechanism 16, the wafer 40 is broken down into various exposure sections eb, which will be exposed one at a time. In Figure 6, a typical wafer is shown being broken into 16 different exposure sections 86, numbered 1 through 16. Each of these exposure sections 86 of wafer 40 is aligned beneath mask 38, one at a time, and each aligned section 86 is then exposed. Within each section, one or several semiconductor chips may be exposed. The limiting factor on each section is the size of the membrane portion of mask 38 which is transmissive to X-rays. The area of each exposure section 86 is significantly less than the size of wafer 40 which may be as much six or more inches in diameter. While a wafer 40 is generally considered to have a very flat surface, when view under extreme magnification, as see in Figure 7, the wafer 40 surface still varies slightly along the length thereof. The peak to valley variations may be as much as 2 microns. This difference may be significantly increased after many layers of resist material and further processing the wafer have occurred.

In Figure 7, the arrows 88 define two adjacent exposure various sections 86 on wafer 40. As can be seen in Figure 7, the average plane will vary between different exposure sections of wafer 40. If the third dimension had been shown in Figure 7, different additional tip and tilt alignment of the plane would have been shown, based on the peaks and valleys of the wafer 40. Further, the uneven application of photoresist may increase the peak to valley variation in a wafer. Because of this unevenness along the top of wafer 40, it is necessary to adjust the gap 39 based on the average plane of each exposure section 86 of wafer 40. The apparatus heretofore described with respect to wafer handling mechanisms 16 is adapted to accomplish this adjustment.

Referring again to Figure 3, sensors 60-1, 60-2 and 60-3, positioned between substage 50 and X stage 48, are each capacitive sensors which provide a voltage signal to controller 90. Controller 90 may be any conventional digital computer system with appropriate input/putput devices, such as analog to digital converters, capable of receiving signal from and providing signals to different components, such as the sensors and motors, in mechanism 16. Sensor 74 is also a capacitive sensor and provides a voltage to controller 90. In the case of capacitive sensors 60-1, 60-2, 60-3 and sensor 74, the voltage provided thereby manifest the distance from the end of the sensor to a conductive object, such as substage 50 or a conductive portion on X-ray chamber sensor 76. For example, sensors 60-1, 60-2, 60-3 and 74 may be capacitive sensors manufactured and sold by ADE Corp. of Newton, Mass. under model number 3800 and are accurate sensing a distance to within 0.05 microns.

The X-ray chamber sensor 76 include three air probe sensor 92, 94, and 96 positioned with respect to one another, as shown in Figure 4. The distance between each sensors 92, 94, and 96 is selected so that all three sensors 92, 94, and 96 fit within an exposure section 86 of wafer 40. In the preferred embodiment, sensors 92, 94 and 96 are spaced as far apart as possible to still fit within one of the exposure sections 86. The air sensors 92, 94, and 96 operate by providing a flowing column of air against a solid surface, such as wafer 40, and measuring the back pressure of that column of air. The back pressure is a manifestation of the distance between the particular air sensor and the solid surface. Air sensor 92, 94, and 96 are accurate sensing a distance to within 0.05 microns.

Referring now to Figures 8, 9, and 10 the manner in which apparatus 16 operates to adjust the plane for each of the exposure sections 86 will now be described. The algorithms described with respect to Figures 8, 9, and 10 may be programed into controller 90, which controls the various components, such as the motors, sensors, alignment systems and interferometer, to perform the functions indicated by Figures 8, 9, and 10. In particular, controller 90 is coupled to read the values provided by sensors 60-1, 60-2, 60-3, 74, 92, 94, and 96. Further, controller 90 provides signals to and receive signals from the interferometer for precisely determining the exact X and Y position of mechanism 16 and controller 90 receives signals from the alignment systems (not shown) for aligning a particular section. 86 of wafer 40 properly beneath mask 38. In response to these signals, controller 90 provides signals to control the various motors associated with mechanism 10, including the X direction motor and Y direction motor, theta motor, course Z motor 70, and the fine Z motor assemblies 58-1, 58-2 and 58-3.

Refering specifically to Figure 8, the Locate Mask Plane algorithm 104 is executed one time after each new mask 38 is positioned against exposure column 36. A new mask 38 may be positioned by the use of the course Z motor 70. First the new mask 38 is prealigned and placed on plate 68, and the course Z motor 70 and fine Z motor assemblies 58-1, 58-2 and 58-3 raise chuck 42 until the mask 30 is approximately 20 microns beneath exposure column 36. After properly aligning the mask using the alignment system, a vacuum chuck is turned on and mask 38 is held in place, as illustrated in Figure 3. While not shown in Figure 3, air sensors may be included within exposure column 36 to assist in determining the 20 micron distances from column 36.

Once mask 38 is properly positioned in exposure column 36, algorithm 104, shown in Figure 8, is executed to locate the plane of mask 38. Knowing the plane of mask 38, of course, is necessary in order to

ultimately accomplish the goal of placing wafer 40 at a fixed gap 39 distance below mask 38. In order for the gap 39 distance to remain fixed, the plane of wafer 40 must be made parallel to the plane of mask 38.

Since mask 38 is a replaceable item, slight variations in the plane from mask to mask can be anticipated. Hence, it is necessary to determine the plane of mask 38 relative to a fixed structure within system 10 and this fixed structure is the plane of sensors 76. To do this, first, according to block 106 in algorithm 104, course Z motor 70 is moved to its upper position, and the fine Z motor assemblies 58-1, 58-2 and 58-3, are moved to their mid-range position. The exact position is not critical for the performance of the block 106 function. Next, according to block 108, the controller 90 provides signals to the X and Y drive motors and positions sensor 74 beneath a point adjacent to sensor 92 of sensors 76. At this point, the controller 90 reads the value provided by sensors 74, and sensors 60-1, 60-2 and 60-3. The reading for sensors 60-1, 60-2 and 60-3 is stored for future use to determine any drift which may occur over longer periods of time, including the time between the changes of mask 38.

Next, according to block 110, controller 90 provides signals to the X and Y drive motors until such time as sensor 74 is positioned adjacent to sensor 94. Again controller 90 reads sensor 74 and stores the value. Finally according to block 112, the X and Y drive motors move sensor 74 adjacent to sensor 96 and the sensor 74 value is again read and stored. At this point in time, three points adjacent to sensors 92, 94 and 96 on the plane of sensors 76 are known. These three points, thus, define a known physical plane within the system which remains constant over time. This defined plane can now be used as a reference plane from which other planes can be measured.

Next according to blocks 114, 116 and 118, the X and Y drive motors are engaged to move sensor 74 beneath three points 98, 100 and 102 on mask 38. These points 98, 100 and 102 are seen in Figure 5 and are ideally positioned near the outer edge of mask 38 at approximately equilateral angles. At the time sensor 74 is positioned beneath each of the points 98, 100 and 102, the voltage value provided sensor 74 is read and stored by controller 90.

Now, three points from the sensor 76 plane are known and three points from mask 38 plane are known. From this information as indicated by block 120, controller 90 calculates necessary offset values for sensors 92, 94 and 96 relative to the plane defined by the three points 98, 100 and 102 on mask 38. The calculated offset values permit sensors 92, 94 and 96 to indicate values of a plane parallel to the mask 38 plane. The calculated offset value for sensors 92, 94 and 96 must take into account both the mechanical difference between the sensors 92, 94 and 96 and the differences in alignment of the plane of sensors 92, 94 and 96 and the plane of mask 38. Further, the distance d, shown in Figure 3 as that distance between the plane of sensors 92, 94 and 96 and the plane of mask 38, must be considered in calculating the offset value. By calculating these offset values, when the readings provided by the three sensors 92, 94 and 96 are added to the offset values, the plane of the object sensed (e.g. wafer 40) is parallel to the plane of mask 38. At this point, as indicated by block 122 the execution of the Locale Mask Plan algorithm 104 is complete.

After the mask plane is located, a wafer 40 is prealigned and placed on to plate 68 of chuck 42 for exposure by X-ray lithography system 10. Prior to exposing the resist layer of wafer 40, it is necessary to globally level and align, as indicated by algorithm 124 in Figure 9. First, according to block 126, controller 90 directs the X and Y drive motors to operate until global alignment mark 166 of wafer 40 is beneath sensor 92. The global alignment mark 166, as well as two other arbitrary locations 168 and 170 are shown on wafer 40 in Figure 6. Ideally these three locations 166, 168 and 170 are positioned near the edge of wafer 40 and spaced sufficiently far apart so the a global plane for wafer 40 can be determined. As will be described hereafter with respect to Figure 10, the individual planes for each of the exposure sections 86 will be determined relative to the global plane.

After global alignment mark 166 is positioned beneath sensor 92, then, according to block 130, the fine Z motors 58-1, 58-2 and 58-3 are moved until sensor 92 indicates that the distance to mark 166 on wafer 40 is equal to the ideal gap 39 distance of 20 microns. In making the determination of the gap 39 distance, the offset value calculated at block 120 for sensor 92 is utilized. Next, according to blocks 130 and 132 the X and Y drive motors are engaged until points 168 and 170 are positioned beneath sensor 92 and the sensor 92 value is read. At this point, three values, which may be different, have been read for the three points 166, 168 and 170 on wafer 40. Each of these value represent a different distance relative to the desired 20 micron gap 39 distance. Next, as indicated by block 134, a set of three equations are solved in order to determine the three settings for fine Z motor assemblies 58-1, 58-2 and 58-3 in order that the global plane of water 40 is parallel to the plane of mask 38. These equations are as follows:

$$P1 = r1 \cdot q1 + r2 \cdot q2 + r3 \cdot q3$$
$$P2 = s1 \cdot q1 + s2 \cdot q2 + s3 \cdot q3$$
$$P3 = t1 \cdot q1 + t2 \cdot q2 + t3 \cdot q3$$

where P1, P2, P3 are the measured distance from the sensor 92 to wafer 40, at the three points 166, 168 and 170; r, s, t are functions of mechanism 16 and sensor 92 geometry and are known constants for each machine 10; and q1, q2, q3 are the distance that each motor assembly 58-1, 58-2 and 58-3 must be moved to bring about the required change in wafer 40 to air sensor 92 distance so that the global plane of wafer

40 is parallel to mask 38.

After the above three equations are solved, the values of q1, q2 and q3 will be known. At this point, controller 90 sends proper signals to each of motor assemblies 58-1, 58-2 and 58-3 to cause fine Z movement, such that the globally defined plane of wafer 40 is made parallel to the plane of mask 38. Then, according to block 136, controller 90 transmits signal to the X and Y drive motors to cause wafer 40 to be moved beneath exposure column 36 and properly aligned therewith. At this point, as indicated by block 138, the Global Level and Align algorithm is completed.

Referring now to Figure 10, XRL system 10 is almost ready to begin exposing the photoresist layer of wafer 40. However, before this can be done, it is necessary to determine the specific plane of each of the exposure sections 86 of wafer 40, in as much as these individual sections 86 may have a somewhat different plane that the global plane of wafer 40. Thus, the Map And Expose Wafer Algorithm is executed. First, according to block 142, controller 90 generates signals to the X and Y drive motors to cause site 1 to be moved under sensors 92, 94 and 96. Next according to block 144, the values provided by sensors 92, 94 and 96 are read and the offset values from block 120 added and the equations, described above with respect to block 134, are again solved for the plane of site 1. At this point, as indicated at block 146, motor assemblies 58-1, 58-2 and 58-3 are issued commands to level site 1 with respect to the mask plane.

Next according to block 148, a determination is made whether the site is level. This determination can be quickly made by determining whether the offset adjusted values provided by the sensors 92, 94 and 96 are the same as these calculated. If not, the function at blocks 144 and 146 is repeated. If the site is level, then according to block 150, the values of sensors 60-1, 60-2 and 60-3 are stored for later use. Next, according to block 152, a determination is made whether the last site has been leveled. If not, then according to block 154, the X and Y drive motors move wafer 40 so that the next site is beneath sensors 92, 94 and 96 and the next site is leveled beginning with block 144, as just described.

If at block 152, it was determined that the last site had been leveled, then according to block 156 the X and Y drive motors move site 1 beneath the exposure column 36. Site 1 is then aligned with mask 38 and according to block 158, fine Z motor assemblies 58-1, 58-2 and 58-3 are set so that the sensor 60-1, 60-2 and 60-3 associated therewith read the same as the values stored for site 1 with respect to block 150. With this setting, site 1 is parallel to and the proper gap 39 distance from mask 38. At that point, controller 90 generates commands to cause the laser 12 to provide laser beam 18 causing X-rays to be generated and site 1 to be exposed.

Next, according to block 160, a determination is made whether the last site has been exposed. If not, controller 90 issues commands to cause the X and Y drive motors to move and align the next site beneath the exposure column and block 158 is repeated for the next site. When, at block 160, the determination is made that the last site was exposed the Map And Exposed Wafer algorithm ends, as indicated by block 164, and wafer 40 is removed and a new wafer is placed on plate 68 for further processing. The new wafer 40 must then be globally leveled and aligned and each site thereof must leveled and aligned before being exposed.

Claims

1. A stepper system (16) for a lithography machine (10) of the type used to expose a pattern on a resist covered semi-conductor wafer (40), one section (86) at a time, said stepper system (16) including means (42 and 50) for holding said wafer (40), means (36) for holding a pattern defining mask (38) in a given plane, means (46 and 48) for moving said wafer holding means (68) past said mask (38) in integral steps, such that one section (86) at a time of said wafer (40) becomes aligned with said mask (38), and means (12, 14, 28) for directing energy through said mask (38) to expose said pattern on said aligned section (86) of said wafer (40), characterised by means (74, 92, 94, 96, 98, 100, 102) for determining a section plane of each section (86) of said wafer (40) relative to said given plane by detecting at least three different points in each section; and means (58-1, 58-2, 58-3, 60-1, 60-2 and 60-3), in response to said means (74, 92, 94, 96, 98, 100, 102) for determining, for adjusting the plane of said wafer (40), as each section (86) of said wafer (40) becomes aligned with said mask (38), to cause that aligned section (86) to be in a desired relationship to said given plane.

2. The stepper system according to claim 1 characterised in that said desired relationship is the section plane of said section being parallel to said given plane.

3. The stepper system according to claim 2 characterised in that said means for determining (74, 92, 94, 96, 98, 100, 102) further determines the plane of said mask (38) as said given plane.

4. The stepper system according to claim 1, 2 or 3 characterised in that said means (74, 92, 94, 96, 98, 100, 102) for determining includes three separated first sensors (92, 94 and 96) affixed to said mask holding means (36), said three first sensors (92, 94 and 96) being positioned to be within an area (76) corresponding to the area of each wafer (40) section (86); a second sensor (74) affixed to said wafer holding means (42 and 50); three separated vertical motors (58-1, 58-2 and 58-3) affixed between said moving

means (46 and 48) and said wafer holding means (42 and 50) for adjusting the plane of said wafer holding means (42 and 50) with respect to said moving means (46 and 48); and control means (90) for controlling said moving means (46 and 48), said three first sensors (92, 94 and 96), said second sensor (74) and said three motors (58-1, 58-2 and 58-3) to position each section (86) of said wafer (40) beneath and parallel to said mask (38).

5. The stepper system according to claim 4 characterized in that said wafer holding means (42 and 50) includes a plate (50); and characterized in that each motor (58-1, 58-2 and 58-3) is positioned between said moving means (46 and 48) and said plate (50), said motors (58-1, 58-2 and 58-3) adjusting the plane of said plate (50) upon command of said control means (90).

6. The stepper system according to claim 4 or 5 characterized in that said control means (90) controls said motors (58-1, 58-2 and 58-3) independently in response to signals provided from said three first sensors (92, 94 and 96) and said second sensor (74).

7. The stepper system according to claim 4 characterized in that each of said sensors (74, 92, 94, and 96) provides a signal to said control means (90) manifesting the distance from that sensor (74, 92, 94, and 96) to another object; in that said control means (90) provides signals to said moving means (46 and 48) to move said second sensor (74) to three separated first desired positions (beneath 92, 94 and 96) with respect to each of said first sensors (92, 94 and 96), said second sensor (74) providing a signal to said control means (90) when at each of said three first desired positions (beneath 92, 94 and 96) manifesting the distance from said second sensor (74) to each of said first desired positions (beneath 92, 94 and 96); and in that said control means (90) provides signals to said moving means (46 and 48) to move said second sensor (74) to at least three separated second desired positions (beneath 98, 100 and 102) with respect to said mask (38), said sensor (74) providing a signal to said control means (90) when at each of said three second desired positions (beneath 98, 100 and 102) manifesting the distance from said second sensor (74) to each of said second desired positions (beneath 98, 100 and 102).

8. The stepper system according to claim 7 characterized in that said control means (90) calculates relative offset values for said first sensors (92, 94 and 96) based upon the relative differences in the signals provided to said control means (90) by said second (74) sensor when at said first and second desired positions (beneath 92, 94, 96, 98, 100 and 102).

9. The stepper system according to claim 8 characterized in that said control means (90) provides a signal to said moving means (46 and 48) to move to a first predetermined location (166) of said wafer (40) a predetermined distance under one (92) of said first sensors (92, 94 and 96), said first predetermined distance being the desired distance between said mask (38) and said wafer (40), plus said relative offset value, said control means (90) thereafter moving, one at a time, second and third predetermined location (168 and 170) of said wafer (40) under said one first sensor (92) and said one first sensor (92) providing a signal to said control means (90) manifesting the distance between said one first sensor (92) and said respective second and third predetermined locations (168 and 170).

10. The stepper system according to claim 9 characterized in that said control means (90) calculates the global plane of said wafer (40) in response to said one first sensor (92) signals manifesting the distance between said one first sensor (92) and said respective first, second and third predetermined locations (166, 168 and 170) and provides signals to said motors (58-1, 58-2 and 58-3) to globally level said wafer (40) with respect to said one first sensor (92), so that said wafer (40) is globally parallel to said mask (38).

11. The stepper system according to claim 10 characterized in that said control means (90) provides a signal to said moving means (46 and 48) to move to a first section (1) of said wafer (40) beneath said three first sensors (92, 94 and 96), said three first sensors (92, 94 and 96) providing signals to said control means (90) manifesting the distance between each first sensor (92, 94 and 96) and said first section (1).

12. The stepper system according to claim 11 characterized in that said control means (90) calculates the plane of said first section (1) in response to said three first sensors (92, 94 and 96) signals manifesting the distance between each first sensor (92, 94 and 96) and said first section (1); in that said control means (90) provides signals to said moving means (46 and 48) to move said first section (1) into alignment with said mask (38); and in that said control means (90) provides signals to said motors (58-1, 58-2 and 58-3) to level said first section (1) with respect to said first sensors (92, 94 and 96), so that said first section (1) is parallel to said mask (38).

13. The stepper system according to claim 12 characterised in that the said control means (90) provides a signal to said moving means (46 and 48) to move to a second section (2) of said wafer (40) beneath said three first sensors (92, 94 and 96), said three first sensors (92, 94 and 96) providing signals to said control means (90) manifesting the distance between each first sensors (92, 94 and 96) and said second section (2); in that said control means (90) calculates the plane of said second section (2) in response to said three first sensor (92, 94 and 96) signals manifesting the distance between each first sensor (92, 94 and 96) and said second section (2); in that said control means (90) provides signals to said moving means (46 and 48) to move said second section

(2) into alignment with said mask (38); and in that said control means (90) provides signals to said motors (58-1, 58-2 and 58-3) to level said second section (2) with respect to said first sensors (92, 94 and 96) so that said second section (2) is parallel to said mask (38).

14. A method of exposing a resist covered semiconductor wafer (40) in a stepper system (16) for a lithography machine (10) in which one section (86) at a time of said wafer (40) is aligned with a pattern defining mask (38) and energy (34) is applied through said mask (38) to expose said pattern on that aligned section (86), characterised by the steps of determining a section plane of each section (86) of said wafer (40) relative to the plane of said mask (38) by detecting at least three different points in each section; and adjusting the plane of said wafer (40) each time a section (86) of said wafer (40) is aligned with said mask (38) to cause the plane of that aligned section (86) to be in a desired relation with respect to said given plane.

15. The method according to claim 14 characterised in that said desired relation is parallel.

16. The method according to claim 14 characterized in that said method further includes the step of determining the plane of said mask (38).

17. The method according to claim 14 characterized in that said step of determining includes the steps of locating the plane of said mask (38) relative to a fixed plane (76) and globally leveling said wafer (40) with respect to said located mask (38) plane.

18. The method according to one of claims 14 through 17 characterized in that said step of adjusting includes storing data manifesting the relative position of three points (beneath 92, 94 and 96) in each section (86) with respect to a knon position (76).

19. The method according to claim 17 characterized in that said wafer (40) is held by a mechanism (16) which moves said wafer (40) in the x, y and z linear directions and which rotates said wafer (40) about the x, y and z axis, said mechanism (16) having a first distance sensor (74) positioned in fixed relationship to said wafer (40) and a second distance sensor (92, 94 and 96) positioned in relationship to said fixed plane (76); characterized in that said step of locating includes moving said mechanism (16) in the x and y directions, when at a predefined z position, so that said first sensor (74) is in a predetermined relationship, one at a time, with three predefined points (beneath 92, 94 and 96) on said fixed plane (76) and reading the distance sensed by said first sensor (74) at each of said three points (beneath 92, 94 and 96), moving said mechanism (16) in the x and y directions, when at said predefined z position, so that said first sensor (74) is in a predetermined relationship, one at a time, with three predefined points (98, 100 and 102) on said mask (38), each of said predetermined mask points (98, 100 and 102) being paired with one of said fixed plane points (beneath 92, 94 and 96), and calculating the offset distance between said fixed plane (76) and mask (38) for each of said three points pairs (beneath 92, 94 and 96 and 98, 100 and 102).

20. The method according to claim 19 characterized in that said step of globally leveling includes the steps of moving said mechanism (16) in the x and y directions, when at a second predefined z position, so that said second sensor (92, 94 and 96) is in a predetermined relationship, one at a time, with three spaced apart points (166, 168 and 170) on said wafer (40) and reading the distance sensed by said second sensor (166, 168 and 170) at each of said three points (166, 168 and 170); and moving said wafer (40) around said x axis and said y axis until said wafer (40) is parallel to said mask (38) plane.

21. The method according to claim 20 characterized in that said wafer (40) has a plurality of predefined and presized sections (86), each of which is to be exposed and said second sensor (92, 94 and 96) includes three triangularly positioned individual sensors (92, 94 and 96) for providing a signal manifesting the distance from said sensor (92, 94 and 96) to a fixed point, said three sensors (92, 94 and 96) being positioned with respect to one another to fit within one section (86) of said wafer (40) characterixed in that said step of adjusting includes the steps of moving said mechanism (16) in the x and y directions, while at said a second predefined z position, until said three second sensors (92, 94 and 96) are within one section (86) of said wafer (40), rotating the planar position of said wafer (40) about said x axis and said y axis, storing data manifesting the position of said wafer (40) plane, and moving said mechanism (16) in the x and y directions until said section (86) is aligned with said mask (38) and setting said plane of said wafer (40) in response to said stored data.

22. The method according to claim 21 characterized in that said steps of moving said mechanism (16) in the x and y directions until said three second sensors (92, 94 and 96) are within one section (86) of said wafer (40), rotating the planar position of said wafer (40) about said x axis and said y axis, and storing data manifesting the position of said wafer (40) plane are repeated for each section (86) of said wafer (40) prior to said step of moving said mechanism (16) in the x and y directions until said section (86) is aligned with said mask (38); and in that said step of moving said mechanism (16) in the x and y directions until said section (86) is aligned with said mask (38) and setting said plane of said wafer (40) in response to said stored data is repeated for each section (86) of said wafer (40).

Patentansprüche

1. Ein Schrittschaltsystem (16) für eine Stein-

druckmaschine (10) des Typs, der zum Exponieren eines Musters auf einem mit Fotolack beschichteten Halbleiterplättchen (40), einen Abschnitt (86) zur Zeit, benutzt wird, wobei das besagte Schrittschaltsystem (16) Vorrichtungen 42 und 50) zum Festhalten des besagten Plättchens (40), eine Vorrichtung (36) zum Festhalten eine Musterabgrenzungsmaske (38) in einer gegebenen Ebene, Vorrichtungen (46 und 48), um die besagte Plättchen-Haltevorrichtung (68) in integrierten Schritten in einer solchen Weise an die besagte Maske (38) vorbei zu bewegen, daß ein Abschnitt (86) des besagten Plättchens (40) zur Zeit mit der besagten Maske (38) ausgerichtet wird, und Vorrichtungen (12, 14, 28) einbezieht, um Energie durch die besagte Maske (38) zu leiten und dadurch das besagte Muster auf dem besagten ausgerichteten Abschnitt (86) des besagten Plättchens (40) zu exponieren; gekennzeichnet durch Vorrichtungen (74, 92, 94, 96, 98, 100, 102) zur Bestimmung einer Schnittebene jedes Abschnitts (86) des besagten Plättchens (40) relativ zu der besagten gegebenen Ebene durch Erkennung von mindestens drei verschiedenen Punkten in jedem Abschnitt, und durch Vorrichtungen (58-1, 58-2, 58-3, 60-1, 60-2 und 60-3) in Reaktion auf die besagten Vorrichtungen (74, 92, 94, 96, 98, 100, 102) zur Bestimmung, zum Justieren der Ebene des besagten Plättchens (40), während jeder Abschnitt (86) des besagten Plättchens (40) mit der besagten Maske (38) ausgerichtet wird, um zu bewirken, daß der ausgerichtete Abschnitt (86) in einer geuünschten Beziehung zu der besagten gegebenen Ebene steht.

2. Das Schrittschaltsystem nach Anspruch 1, dadurch gekennzeichnet, daß die besagte gewünschte Beziehung die Schnittebene des besagten Abschnitts ist, der parallel zu der besagten gegebenen Ebene liegt.

3. Das Schrittschaltsystem nach Anspruch 2, dadurch gekennzeichnet, daß die besagten Vorrichtungen zur Bestimmung (74, 92, 94, 96, 98, 100, 102) weiterhin die Ebene der besagten Maske (38) als die besagte gegebene Ebene bestimmen.

4. Das Schrittschaltsystem nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die besagten Vorrichtungen (74, 92, 94, 96, 98, 100, 102) zur Bestimmung drei getrennte erste Sensoren (92, 94 und 96) einbeziehen, die an der besagten Maskenhaltevorrichtung (36) befestigt sind, wobei die besagten drei ersten Sensoren (92, 94 und 96) so positioniert sind, daß sie innerhalb eines Bereichs (76) liegen, der dem Bereich jedes Plättchen(40)-Abschnitts(86) entspricht; einen zweiten Sensor (74), der an den besagten Plättchen-Haltevorrichtungen (42 und 50) befestigt ist; drei getrennte Vertikalmotoren (58-1, 58-2 und 58-3), die zwischen den besagten beweglichen Vorrichtungen (46 und 48) und den besagten Plättchen-Haltevorrichtungen (42 und 50) befestigt sind, um die Ebene der besagten Plättchen-Haltevorrichtungen (42 und 50) mit Bezug auf die besagten beweglichen Vorrichtungen (46 und 48) zu justieren, und eine Steuervorrichtung (90) zum Steuern der besagten beweglichen Vorrichtungen (46 und 48), wobei die besagten drei ersten Sensoren (92, 94 und 96), der besagte zweite Sensor (74) und die besagten drei Motoren (58-1, 58-2 und 58-3) jeden Abschnitt (86) des besagten Plättchens (40) unter der und parallel zur besagten Maske (38) positionieren müssen.

5. Das Schrittschaltsystem nach Anspruch 4, dadurch gekennzeichnet, daß die besagten Plättchen-Haltevorrichtugnen (42 und 50) eine Platte (50) einbeziehen, und dadurch gekennzeichnet, daß jeder Motor (58-1, 58-2 und 58-3) zwischen den besagten beweglichen Vorrichtungen (46 und 48) und der besagten Platte (50) positioniert ist, wobei die besagten Motoren (58-1, 58-2 und 58-3) die Ebene der besagten Platte (50) auf Befehl der besagten Steuervorrichtung (90) justieren.

6. Das Schrittschaltsystem nach Anspruch 4 oder 5, dadurch gekennzeichnet, daß die besagte Steuervorrichtung (90) die besagten Motoren (58-1, 58-2 und 58-3) unabhängig in Reaktion auf Signale steuert, die von den besagten drei ersten Sensoren (92, 94 und 96) und dem besagten zweiten Sensor (74) bereitgestellt werden.

7. Das Schrittschaltsystem nach Anspruch 4, dadurch gekennzeichnet, daß jeder der besagten Sensoren (74, 92, 94 und 96) ein Signal zu der besagten Steuervorrichtung (90) bereitstellt, welches die Entfernung von diesem Sensor (74, 92, 94 und 96) zu einem anderen Objekt anzeigt; dadurch, daß die besagte Steuervorrichtung (90) Signale zu den besagten beweglichen Vorrichtungen (46 und 48) bereitstellt, um den besagten zweiten Sensor (74) zu drei getrennten ersten gewünschten Positionen (unter 92, 94 und 96) mit Bezug zu jedem der besagten ersten Sensoren (92, 94 und 96) zu bewegen, wobei der besagte zweite Sensor (74) ein Signal zu der besagten Steuervorrichtung (90) bereitstellt, wenn er sich in jeder der besagten drei ersten gewünschten Positionen (unter 92, 94 und 96) befindet, wodurch die Entfernung von dem besagten zweiten Sensor (74) zu jeder der besagten ersten Positionen (unter 92, 94 und 96) angezeigt wird; und dadurch, daß die besagte Steuervorrichtung (90) Signale zu den besagten beweglichen Vorrichtungen (46 und 48) bereitstellt, um den besagten zweiten Sensor (74) in mindestens drei getrennte zweite gewünschte Positionen (unter 98, 100 und 102) mit Bezug auf die besagte Maske (38) zu bewegen, wobei der besagte Sensor (74) ein Signal zu der besagten Steuervorrichtung (90) bereitstellt, wenn er sich in jeder der besagten drei zweiten gewünschten Positionen (unter 98, 100 und 102) befindet, wodurch die Entfernung von dem besagten zweiten Sensor (74) zu jeder der besagten zweiten gewünschten Positionen (unter 98, 100 und 102) angezeigt wird.

8. Das Schrittschaltsystem nach Anspruch 7, dadurch gekennzeichnet, daß die besagte Steuervorrichtung (90) relative Versatzwerte für die besagten ersten Sensoren (92, 94 und 96) auf der Basis der relativen Unterschiede in den Signalen errechnet, welche durch den besagten zweiten Sensor (74) zu der besagten Steuervorrichtung (90) bereitgestellt werden, wenn er sich in den besagten ersten und zweiten gewünschten Positionen (unter 92, 94, 96, 98, 100 und 102) befindet.

9. Das Schrittschaltsystem nach Anspruch 8, dadurch gekennzeichnet, daß die besagte Steuervorrichtung (90) ein Signal zu den besagten beweglichen Vorrichtungen (46 und 48) bereitstellt, um sich eine vorherbestimmte Entfernung unter einem (92) der besagten ersten Sensoren (92, 94 und 96) zu einer ersten vorherbestimmten Stelle (166) des besagten Plättchens (40) zu bewegen, wobei die erste vorherbestimmte Entfernung die gewünschte Entfernung zwischen der besagten Maske (38) und dem besagten Plättchen (40), plus dem relativen Versatzwert ist, und wobei die besagte Steuervorrichtung (90) danach - eine zur Zeit - die zweite und dritte vorherbestimmte Stelle (168 und 170) des besagten Plättchens (40) unter den besagten einen ersten Sensor (92) bewegt und der besagte eine erste Sensor (92) ein Signal zu der besagten Steuervorrichtung (90) bereitstellt, wodurch die Entfernung zwischen dem besagten einen ersten Sensor (92) und den besagten jeweiligen zweiten und dritten vorherbestimmten Stellen (168 und 170) angezeigt wird.

10. Das Schrittschaltsystem nach Anspruch 9, dadurch gekennzeichnet, daß die besagte Steuervorrichtung (90) die Globalebene des besagten Plättchens (40) in Reaktion auf die Signale des besagten einen ersten Sensors (92) errechnet, welche die Entfernung zwischen dem besagten einen ersten Sensor (92) und den jeweiligen ersten, zweiten und dritten vorherbestimmten Stellen (166, 168 und 170) anzeigen, und Signale zu den besagten Motoren (58-1, 58-2 und 58-3) bereitstellt, um das besagte Plättchen (40) mit Bezug auf den besagten einen ersten Sensor (92) global abzugleichen, damit das besagte Plättchen (90) zu besagter Maske (38) global parallel liegt.

11. Das Schrittschaltsystem nach Anspruch 10, dadurch gekennzeichnet, daß die besagte Steuervorrichtung (90) ein Signal zu den besagten beweglichen Vorrichtungen (46 und 48) bereitstellt, um sich zu einem ersten Abschnitt (1) des besagten Plättchens (40) unter den besagten drei ersten Sensoren (92, 94 und 96) zu bewegen und Signale zu der besagten Steuervorrichtung (90) bereitzustellen, wodurch die Entfernung zwischen jedem ersten Zensor (92, 94 und 96) und dem besagten ersten Abschnitt (1) angezeigt wird.

12. Das Schrittschaltsystem nach Anspruch 11, dadurch gekennzeichnet, daß die besagte Steuervorrichtung (90) die Ebene des besagten ersten Abschnitts (1) in Reaktion auf die Signale der besagten ersten drei Sensoren (92, 94 und 96) errechnet, welche die Entfernung zwischen jedem ersten Sensor (92, 94 und 96) und dem besagten ersten Abschnitt (1) anzeigen; dadurch, daß die besagte Steuervorrichtung (90) Signale zu den besagten beweglichen Vorrichtungen (46 und 48) bereitstellt, um den besagten ersten Abschnitt (1) in Ausrichtung mit der besagten Maske (38) zu bewegen; und dadurch, daß die besagte Steuervorrichtung (90) Signale zu den besagten Motoren (58-1, 58-2 und 58-3) bereitstellt,um den besagten ersten Abschnitt (1) mit Bezug auf die besagten ersten Sensoren (92, 94 und 96) abzugleichen, damit der besagte erste Abschnitt (1) parall zu besagter Maske (38) liegt.

13. Das Schrittschaltsystem nach Anspruch 12, dadurch gekennzeichnet, daß die besagte Steuervorrichtung (90) ein Signal zu den besagten beweglichen Vorrichtungen (46 und 48) bereitstellt, um einen zweiten Abschnitt (2) des besagten Plättchens (40) unter die besagten drei ersten Sensoren (92, 94 und 96) zu bewegen, wobei die besagten drei ersten Sensoren (92, 94 und 96) Signale zu der besagten Steuervorrichtung bereitstellen, wodurch die Entfernung zwischen jedem der ersten Sensoren (92, 94 und 96) und dem besagten zweiten Abschnitt (2) angezeigt wird; dadurch, daß die besagte Steuervorrichtung (90) die Ebene des besagten zweiten Abschnitts (2) in Reaktion auf die Signale der besagten drei ersten Sensoren (92, 94 und 96) errechnet, wodurch die Entfernung zwischen jedem ersten Sensor (92, 94 und 96) und dem besagten zweiten Abschnitt (2) angezeigt wird; dadurch, daß die besagte Steuervorrichtung (90) Signale zu den besagten beweglichen Vorrichtungen (46 und 48) bereitstellt, um den besagten zweiten Abschnitt (2) in Ausrichtung mit der besagten Maske (38) zu bringen; und dadurch, daß die besagte Steuervorrichtung (90) Signale zu den besagten Motoren (58-1, 58-2 und 58-3) bereitstellt, um den besagten zweiten Abschnitt (2) mit Bezug auf die besagten ersten Sensoren (92, 94 und 96) abzugleichen, damit der besagte zweite Abschnitt (2) parallel zu besagter Maske (38) liegt.

14. Eine Methode zum Exponieren eines mit Fotolack beschichteten Halbleiterplättchens (40) in einem Schrittschaltsystem (16) für eine Steindruckmaschine (10), in der ein Abschnitt (86) des besagten Plättchens (40) zur Zeit mit einer Musterabgrenzungsmaske (38) ausgerichtet und durch die besagte Maske (38) Energie (34) aufgewendet wird, um das besagte Muster auf diesem ausgerichteten Abschnitt (86) zu exponieren, gekennzeichnet durch die (Arbeits)Schritte der Bestimmung einer Schnittebene jedes Abschnitts (86) des besagten Plättchens (40) relativ zu der Ebene der besagten Maske (38) durch Erkennung von mindestens drei verschiedenen Punkten in jedem Abschnitt, und die Justierung der Ebene des besagten Plättchens (40) jedesmal dann,

wenn ein Abschnitt (86) des besagten Plättchens (40) mit der besagten Maske (38) ausgerichtet ist, um zu bewirken, daß die Ebene dieses ausgerichteten Abschnitts (86) in einer gewünschten Beziehung mit Bezug auf die besagte gegebene Ebene liegt.

15. Die Methode nach Anspruch 14, dadurch gekennzeichnet, daß die gewünschte Beziehung parallel ist.

16. Die Methode nach Anspruch 14, dadurch gekennzeichnet, daß die besagte Methode weiterhin den (Arbeits)Schritt der Bestimmung der Ebene der besagten Maske (38) einbezieht.

17. Die Methode nach Anspruch 14, dadurch gekennzeichnet, daß der besagte (Arbeits)Schritt der Bestimmung die (Arbeits)Schritte der Ermittlung der Ebene der besagten Maske (38) relativ zu einer festen Ebene (76) und des globalen Abgleichens des besagten Plättchens (40) mit Bezug auf die Ebene der besagten bestimmten Maske (38) einbezieht.

18. Die Methode nach einem der Ansprüche 14 bis 17, dadurch gekennzeichnet, daß der besagte (Arbeits)Schritt des Justierens das Speichern von Daten einbezieht, welche die Relativposition von drei Punkten (unter 92, 94 und 96) in jedem Abschnitt (86) mit Bezug auf eine bekannte Position (76) anzeigen.

19. Die Methode nach Anspruch 17, dadurch gekennzeichnet, daß das besagte Plättchen (40) durch einen Mechanismus (16) festgehalten wird, der das besagte Plättchen (40) in die x, y und 7 Linearrichtungen bewegt und das besagte Plättchen (40) um die x, y und z Achse dreht, wobei der besagte Mechanismus (16) einen ersten Entfernungssensor (74) aufweist, der in fester Beziehung zu besagtem Plättchen (40) positioniert ist, und einen zweiten Entfernungssensor (92, 94 und 96), der in Beziehung zu der besagten festen Ebene (76) positioniert ist; dadurch gekennzeichnet, daß der besagte (Arbeits) Schritt der Bestimmung die Bewegung des besagten Mechanismus (16) in die x und y Richtungen einbezieht, wenn er sich in einer vorher festgelegten z-Position befindet, so daß sich der erste Sensor (74) in einer vorherbestimmten Beziehung, einer zur Zeit, mit drei vorher festgelegten Punkten (unter 92, 94 und 96) auf der besagten festen Ebene (76) befindet und die durch den besagten ersten Sensor (74) an jedem der besagten drei Punkte (unter 92, 94 und 96) abgefühlte Entfernung abliest und den besagten Mechanismus (16) in die x und y Richtungen bewegt, wenn er sich in der besagten vorher festgelegten z-Position befindet, so daß sich der besagte erste Zensor (74) in einer vorherbestimmten Beziehung, einer zur Zeit, mit drei vorher festgelegten Punkten (98, 100 und 102) befindet, die mit einem der besagten Punkte der festen Ebene (unter 92, 94 und 96) gepaart sind und die Versatzentfernung zwischen der besagten festen Ebene (76) und Maske (38) für jedes der besagten drei Punktpaare (unter 92, 94 und 96 und 98, 100 und 102) errechnet.

20. Die Methode nach Anspruch 19, dadurch gekennzeichnet, daß der besagte (Arbeits)Schritt des globalen Abgleichens die (Arbeits)Schritte der Bewegung des besagten Mechanismus (16) in die x und y Richtungen einbezieht, wenn er sich in einer zweiten. vorher festgelegten z-Position befindet, so daß sich der besagte zweite Sensor (92, 94 und 96) in einer vorherbestimmten Beziehung, einer zur Zeit, mit drei unterteilten Punkten (166, 168 und 170) auf dem besagten Plättchen (40) befindet und die Entfernung abliest, die durch den besagten zweiten Zensor (166, 168 und 170) an jedem der besagten drei Punkte (166, 168 und 170) abgefühlt wird; und das Bewegen des besagten Plättchens (40) um die besagte x-Achse und besagte y-Achse, bis sich das besagte Plättchen (40) parallel zur Ebene der besagten Maske (38) befindet.

21. Die Methode nach Anspruch 20, dadurch gekennzeichnet, daß das besagte Plättchen (40) eine Vielzahl von vorher festgelegten und vorher bemessenen Abschnitten (86) aufweist, von denen ein jeder exponiert werden soll, und der besagte zweite sensor (92, 94 und 96) schließt drei dreieckig positionierte Einzelsensoren (92, 94 und 96) zur Bereitstellung eines Signals ein, welches die Entfernung von dem besagten Sensor (92, 94 und 96) zu einem Festpunkt anzeigt, wobei die besagten drei Sensoren (92, 94 und 96) derartig mit Bezug zueinander positioniert sind, daß sie innerhalb eines Abschnitts (86) des besagten Plättchens (40) passen; dadurch gekennzeichnet, daß der besagte (Arbeits)Schritt des Justierens die (Arbeits)Schritte des Bewegens des besagten Mechanismus (16) in die x und y Richtungen, während er sich in einer zweiten, vorher festgelegten z-Position befindet, einbezieht, bis sich die besagten drei zweiten Sensoren (92, 94 und 96) innerhalb eines Abschnitts (86) des besagten Plättchens (40) befinden, wobei die Planarposition des besagten Plättchens (40) um die besagte x-Achse und die besagte y-Achse gedreht wird, die Position der Ebene des besagten Plättchens (40) manifestierende Daten gespeichert werden und der besagte Mechanismus (16) in die x und y Richtungen bewegt wird, bis der besagte Abschnitt (86) mit der besagten Maske (38) ausgerichtet ist, und die besagte Ebene des besagten Plättchens (40) in Reaktion auf die besagten gespeicherten Daten eingestellt wird.

22. Die Methode nach Anspruch 21, dadurch gekennzeichnet, daß die besagten (Arbeits)Schritte des Bewegens des besagten Mechanismus (16) in die x und y Richtungen, bis sich die besagten drei zweiten Sensoren (92, 94 und 96) innerhalb eines Abschnitts (86) des besagten Plättchens (40) befinden, des Drehens der Planarposition des besagten Plättchens (40) um die besagte x-Achse und die besagte y-Achse, und des Speicherns von Daten welche die Position der Ebene des besagten Plättchens (40) manifestieren, für jeden Abschnitt (86) des besagten Plättchens

(40) vor dem besagten (Arbeits)Schritt des Bewegens des besagten Mechanismus (16) in die x und y Richtungen, bis der besagte Abschnitt (86) mit der besagten Maske (38) ausgerichtet ist, wiederholt werden; und dadurch, daß der besagte (Arbeits)Schritt des Bewegens des besagten Mechanismus (16) in die x und y Richtungen, bis der besagte Abschnitt (86) mit der besagten Maske (38) ausgerichtet ist, und des Einstellens der besagten Ebene des besagten Plättchens (40) in Reaktion auf die besagten gespeicherten Daten für jeden Abschnitt (86) des besagten Plättchens (40) wiederholt wird.

Revendications

1. Système pas à pas (16) pour une machine de lithographie (10) du type utilisé pour exposer un dessin sur une plaquette (40) semi-conductrice recouverte d'un agent photorésistant, une section (86) à la fois, ledit système pas à pas (16) comprenant des moyens (42 et 50) de maintien de ladite plaquette (40), des moyens (36) de maintien d'un masque (38) définissant un dessin dans un plan donné, des moyens (46 et 48) de déplacement desdits moyens (68) de maintien de la plaquette au-delà dudit masque (38) par pas entiers, de manière à ce qu'une section (86) à la fois de ladite plaquette (40) soit alignée avec ledit masque (38), et des moyens (12, 14, 28) pour diriger de l'énergie à travers ledit masque (38) afin d'exposer ledit dessin sur ladite section alignée (86) de ladite plaquette (40), caractérisé par des moyens (74, 92, 94, 96, 98, 100, 102) de détermination d'un plan de section de chaque section (86) de ladite plaquette (40) par rapport audit plan donné en détectant au moins trois points différents dans chaque section ; et des moyens (58-1, 58-2, 58-3, 60-1, 60-2 et 60-3) de réglage pour régler, en réponse auxdits moyens (74, 92, 94, 96, 98, 100, 102) de détermination, le plan de ladite plaquette (40), au moment où chaque section (86) de ladite plaquette (40) est alignée avec ledit masque (38) pour faire en sorte que la section (86) alignée soit dans une relation souhaitée par rapport audit plan donné.

2. Système pas à pas selon la revendication 1, caractérisé en ce que ladite relation souhaitée est le plan de section de ladite section qui est parallèle audit plan donné.

3. Système pas à pas selon la revendication 2, caractérisé en ce que lesdits moyens de détermination (74, 92, 94, 96, 98, 100, 102) déterminent en outre le plan dudit masque (38) comme étant ledit plan donné.

4. Système pas à pas selon l'une quelconque des revendications 1, 2 ou 3, caractérisé en ce que lesdits moyens (74, 92, 94, 96, 98, 100, 102) de détermination comprennent trois premiers capteurs distincts (92, 94 et 96) fixés auxdits moyens (36) de maintien de masque, lesdits trois premiers capteurs (92, 94 et 96) étant placés de manière à se trouver à l'intérieur d'une surface (76) correspondant à la surface de chaque section (86) de plaquette (40) ; un deuxième capteur (74) fixé auxdits moyens (42 et 50) de maintien de plaquette ; trois moteurs verticaux distincts (58-1, 58-2 et 58-3) fixés entre lesdits moyens de déplacement (46 et 48) et lesdits moyens (42 et 50) de maintien de plaquette, afin de régler le plan desdits moyens (42 et 50) de maintien de plaquette par rapport auxdits moyens de déplacement (46 et 48) ; et des moyens de commande (90) pour commander lesdits moyens de déplacement (46 et 48), lesdits trois premiers capteurs (92, 94 et 96), ledit deuxième capteur (74) et lesdits trois moteurs (58-1, 58-2 et 58-3) afin de positionner chaque section (86) de ladite plaquette (40) en dessous dudit masque (38) et parallèlement à celui-ci.

5. Système pas à pas selon la revendication 4, caractérisé en ce que lesdits moyens (42 et 50) de maintien de plaquette comprennent une plaque (50) ; et en ce que chaque moteur (58-1, 58-2 et 58-3) est placé entre lesdits moyens de déplacement (46 et 48) et ladite plaque (50), lesdits moteurs (58-1, 58-2 et 58-3) réglant le plan de ladite plaque (50) sur commande desdits moyens de commande (90).

6. Système pas à pas selon la revendication 4 ou la revendication 5, caractérisé en ce que lesdits moyens de commande (90) commandent lesdits moteurs (58-1, 58-2 et 58-3) indépendamment en réponse à des signaux fournis par lesdits trois premiers capteurs (92, 94 et 96) et ledit deuxième capteur (74).

7. Système pas à pas selon la revendication 4, caractérisé en ce que chacun desdits capteurs (74, 92, 94 et 96) fournit un signal auxdits moyens de commande (90) indiquant la distance entre ce capteur (74, 92, 94 et 96) et un autre objet ; en ce que lesdits moyens de commande (90) fournissent des signaux auxdits moyens de déplacement (46 et 48) afin de déplacer ledit deuxième capteur (74) vers trois premières positions souhaitées distinctes (en-dessous de 92, 94 et 96) par rapport à chacun desdits premiers capteurs (92, 94 et 96), ledit deuxième capteur (74) fournissant un signal auxdits moyens de commande (90) quand il est à chacune desdites trois premières positions souhaitées (en-dessous de 92, 94 et 96) indiquant la distance entre ledit deuxième capteur (74) et chacune desdites premières positions souhaitées (en dessous de 92, 94 et 96) ; et en ce que lesdits moyens de commande (90) fournissent des signaux auxdits moyens de déplacement (46 et 48) afin de déplacer ledit deuxième capteur (74) vers au moins trois deuxièmes positions souhaitées distinctes (en-dessous de 98, 100 et 102) par rapport audit masque (38), ledit capteur (74) fournissant un signal auxdits moyens de commande (90) quand il est à chacune desdites trois deuxièmes positions souhaitées (en

dessous de 98, 100 et 102) indiquant la distance entre ledit deuxième capteur (74) et chacune desdites deuxièmes positions souhaitées (en-dessous de 98, 100 et 102).

8. Système pas à pas selon la revendication 7, caractérisé en ce que lesdits moyens de commande (90) calculent des valeurs de déplacement relatif pour lesdits premiers capteurs (92, 94 et 96) sur la base des différences relatives dans les signaux fournis auxdits moyens de commande (90) par ledit deuxième capteur (74) quand il est auxdites premières et deuxièmes positions souhaitées (en-dessous de 92, 94, 96, 98, 100 et 102).

9. Système pas à pas selon la revendication 8, caractérisé en ce que lesdits moyens de commande (90) fournissent un signal auxdits moyens de déplacement (46 et 48) pour les déplacer jusqu'à un premier emplacement prédéterminé (166) de ladite plaquette (40) à une distance prédéterminée sous l'un (92) desdits premiers capteurs (92, 94 et 96), ladite première distance prédéterminée étant la distance souhaitée entre ledit masque (38) et ladite plaquette (40), plus ladite valeur de déplacement relatif, lesdits moyens de commande (90) les déplaçant ensuite jusqu'aux deuxième et troisième emplacements prédéterminés (168 et 170), l'un après l'autre, de ladite plaquette (40) sous ledit un (92) desdits premiers capteurs et ledit un (92) desdits premiers capteurs fournissant un signal auxdits moyens de commande (90) indiquant la distance entre ledit un (92) desdits premiers capteurs et lesdits deuxième et troisième emplacements prédéterminés respectifs (168 et 170).

10. Système pas à pas selon la revendication 9, caractérisé en ce que lesdits moyens de commande (90) calculent le plan global de ladite plaquette (40) en réponse aux signaux dudit un (92) desdits premiers capteurs indiquant la distance entre ledit un (92) desdits premiers capteurs et lesdits premier, deuxième et troisième emplacements prédéterminés respectifs (166, 168 et 170) et fournissent des signaux auxdits moteurs (58-1, 58-2 et 58-3) pour mettre ladite plaquette (40) globalement à niveau par rapport audit un (92) desdits premiers capteurs, de manière à ce que ladite plaquette (40) soit globalement parallèle audit masque 38.

11. Système pas à pas selon la revendication 10, caractérisé en ce que lesdits moyens de commande (90) fournissent un signal auxdits moyens de déplacement (46 et 48) afin de déplacer une première section (1) de ladite plaquette (40) en dessous desdits trois premiers capteurs (92, 94 et 96), lesdits trois premiers capteurs (92, 94 et 96) fournissant des signaux auxdits moyens de commande (90) indiquant la distance entre chacun des premiers capteurs (92, 94 et 96) et ladite première section (1).

12. Système pas à pas selon la revendication 11, caractérisé en ce que lesdits moyens de commande (90) calculent le plan de ladite première section (1) en réponse aux signaux desdits trois premiers capteurs (92, 94 et 96) indiquant la distance entre chacun des premiers capteurs (92, 94 et 96) et ladite première section (1) ; en ce que lesdits moyens de commande (90) fournissent des signaux auxdits moyens de déplacement (46 et 48) pour positionner ladite première section (1) en alignement avec ledit masque (38) ; et en ce que lesdits moyens de commande (90) fournissent des signaux auxdits moteurs (58-1, 58-2 et 58-3) pour mettre ladite première section (1) à niveau par rapport auxdits premiers capteurs (92, 94 et 96) de manière à ce que la première section (1) soit parallèle audit masque (38).

13. Système pas à pas selon la revendication 12, caractérisé en ce que lesdits moyens de commande (90) fournissent un signal auxdits moyens de déplacement (46 et 48) afin de déplacer une deuxième section (2) de ladite plaquette (40) en-dessous des trois premiers capteurs (92, 94 et 96), lesdits trois premiers capteurs (92, 94 et 96) fournissant des signaux auxdits moyens de commande (90) indiquant la distance entre chacun des premiers capteurs (92, 94 et 96) et ladite deuxième section (2) ; en ce que lesdits moyens de commande (90) calculent le plan de ladite deuxième section (2) en réponse aux signaux desdits trois premiers capteurs (92, 94 et 96) indiquant la distance entre chacun des premiers capteurs (92, 94 et 96) et ladite deuxième section (2) ; en ce que lesdits moyens de commande (90) fournissent des signaux auxdits moyens de déplacement (46 et 48) pour placer ladite deuxième section (2) en alignement avec ledit masque (38) ; et en ce que lesdits moyens de commande (90) fournissent des signaux auxdits moteurs (58-1, 58-2 et 58-3) pour mettre ladite deuxième section (2) à niveau par rapport auxdits premiers capteurs (92, 94 et 96) de manière à ce que ladite deuxième section (2) soit parallèle audit masque (38).

14. Procédé pour exposer une plaquette (40) semi-conductrice recouverte d'un agent photorésistant dans un système pas à pas (16) pour une machine de lithographie (10) dans lequel une section (86) à la fois de ladite plaquette (40) est alignée avec ledit masque (38) définissant un dessin et de l'énergie (34) est appliquée à travers ledit masque (38) afin d'exposer ledit dessin sur cette section (86) alignée, caractérisé par les étapes de détermination d'un plan de section de chaque section (86) de ladite plaquette (40) par rapport au plan dudit masque (38) en détectant au moins trois points différents dans chaque section ; et réglage du plan de ladite plaquette (40) à chaque fois qu'une section (86) de ladite plaquette (40) est alignée avec ledit masque (38) pour faire que le plan de cette section alignée (86) soit dans une relation souhaitée par rapport audit plan donné.

15. Procédé selon la revendication 14, caractérisé en ce que ladite relation souhaitée est une rela-

tion de parallélisme.

16. Procédé selon la revendication 14, caractérisé en ce que ledit procédé comprend en outre l'étape de détermination du plan dudit masque (38).

17. Procédé selon la revendication 14, caractérisé en ce que ladite étape de détermination comprend les étapes de repérage du plan dudit masque (38) par rapport à un plan fixe (76) et de mise à niveau global de ladite plaquette (40) par rapport audit plan de masque (38) repéré.

18. Procédé selon l'une quelconque des revendications 14 à 17, caractérisé en ce que ladite étape de réglage comprend la mémorisation de données indiquant la position relative de trois points (en-dessous de 92, 94 et 96) dans chaque section (86) par rapport à une position connue (76).

19. Procédé selon la revendication 17, caractérisé en ce que ladite plaquette (40) est maintenue par un dispositif (16) qui déplace ladite plaquette (40) dans les directions rectilignes x, y et z et qui tournent ladite plaquette (40) autour des axes x, y et z, ledit dispositif (16) possédant un premier capteur de distance (74) positionné dans une relation fixe par rapport à ladite plaquette (40) et un deuxième capteur de distance (92, 94 et 96) positionné dans une certaine relation par rapport audit plan fixe (76) ; caractérisé en ce que ladite étape de repérage comprend le déplacement dudit dispositif (16) dans les directions x et y, quand il est dans une position prédéfinie z, de manière à ce que ledit premier capteur (74) soit dans une relation prédéterminée avec trois points prédéterminés, un à la fois, (en-dessous de 92, 94 et 96) sur ledit plan fixe (76) et la lecture de la distance détectée par ledit premier capteur (74) à chacun desdits trois points (en dessous de 92, 94 et 96), le déplacement dudit dispositif (16) dans les directions x et y, quand il est à la position prédéfinie z, de manière à ce que ledit premier capteur (74) soit dans une relation prédéterminée avec trois points prédéfinis (98, 100 et 102), un à la fois, sur ledit masque (38), chacun desdits points de masque prédéterminés (98, 100 et 102) étant conjugués avec l'un desdits points de plan fixes (en dessous de 92, 94 et 96) et le calcul de la distance de décalage entre ledit plan fixe (76) et le masque (38) pour chacune desdites trois paires de points (en dessous de 92, 94 et 96 et 98, 100 et 102).

20. Procédé selon la revendication 19, caractérisé en ce que ladite étape de mise à niveau global comprend les étapes de déplacement dudit dispositif (16) dans les directions x et y, quand il est à une deuxième position prédéfinie z, de manière à ce que ledit deuxième capteur (92, 94 et 96) soit dans une relation prédéterminée avec trois points écartés les uns des autres (166, 168 et 170), un à la fois, sur la plaquette (40) et de lecture de la distance détectée par ledit deuxième capteur (166, 168 et 170) à chacun desdits trois points (166, 168 et 170); et de déplacement de ladite plaquette (40) autour dudit axe x et dudit axe y jusqu'à ce que ladite plaquette (40) soit parallèle audit plan de masque (38).

21. Procédé selon la revendication 20, caractérisé en ce que ladite plaquette (40) possède une pluralité de sections (86) prédéfinies et prédimensionnées, chacune d'elles devant être exposée et en ce que ledit deuxième capteur (92, 94 et 96) comprend trois capteurs individuels (92, 94 et 96) positionnés en triangle pour fournir un signal indiquant la distance entre ledit capteur (92, 94 et 96) et un point fixe, lesdits trois capteurs (92, 94 et 96) étant positionnés les uns par rapport aux autres de manière à s'insérer dans une section (86) de ladite plaquette (40), en ce que ladite étape de réglage comprend les étapes de déplacement dudit dispositif (16) dans les directions x et y, pendant qu'il est à la deuxième position prédéfinie z, jusqu'à ce que lesdits trois deuxièmes capteurs (92, 94 et 96) soient à l'intérieur d'une section (86) de ladite plaquette (40), de rotation de la position plane de ladite plaquette (40) autour dudit axe x et dudit axe y, de mémorisation de données indiquant la position dudit plan de plaquette (40), et de déplacement dudit dispositif (16) dans les directions x et y jusqu'à ce que ladite section (86) soit alignée avec ledit masque (38), et de réglage dudit plan de ladite plaquette (40) en réponse auxdites données mémorisées.

22. Procédé selon la revendication 21, caractérisé en ce que lesdites étapes de déplacement dudit dispositif (16) dans les directions x et y jusqu'à ce que lesdits trois deuxièmes capteurs (92, 94 et 96) soient à l'intérieur d'une section (86) de ladite plaquette (40), de rotation de la position plane de ladite plaquette (40) autour dudit axe x et dudit axe y, et de mémorisation de données indiquant la position dudit plan de plaquette (40), sont répétées pour chaque section (86) de ladite plaquette (40) avant ladite étape de déplacement dudit dispositif (16) dans les directions x et y jusqu'à ce que ladite section (86) soit alignée avec ledit masque (38) ; et en ce que ladite étape de déplacement dudit dispositif (16) dans les directions x et y jusqu'à ce que ladite section (86) soit alignée avec ledit masque (38) et de réglage dudit plan de ladite plaquette (40) en réponse auxdites données mémorisées est répétée pour chaque section (86) de ladite plaquette (40).

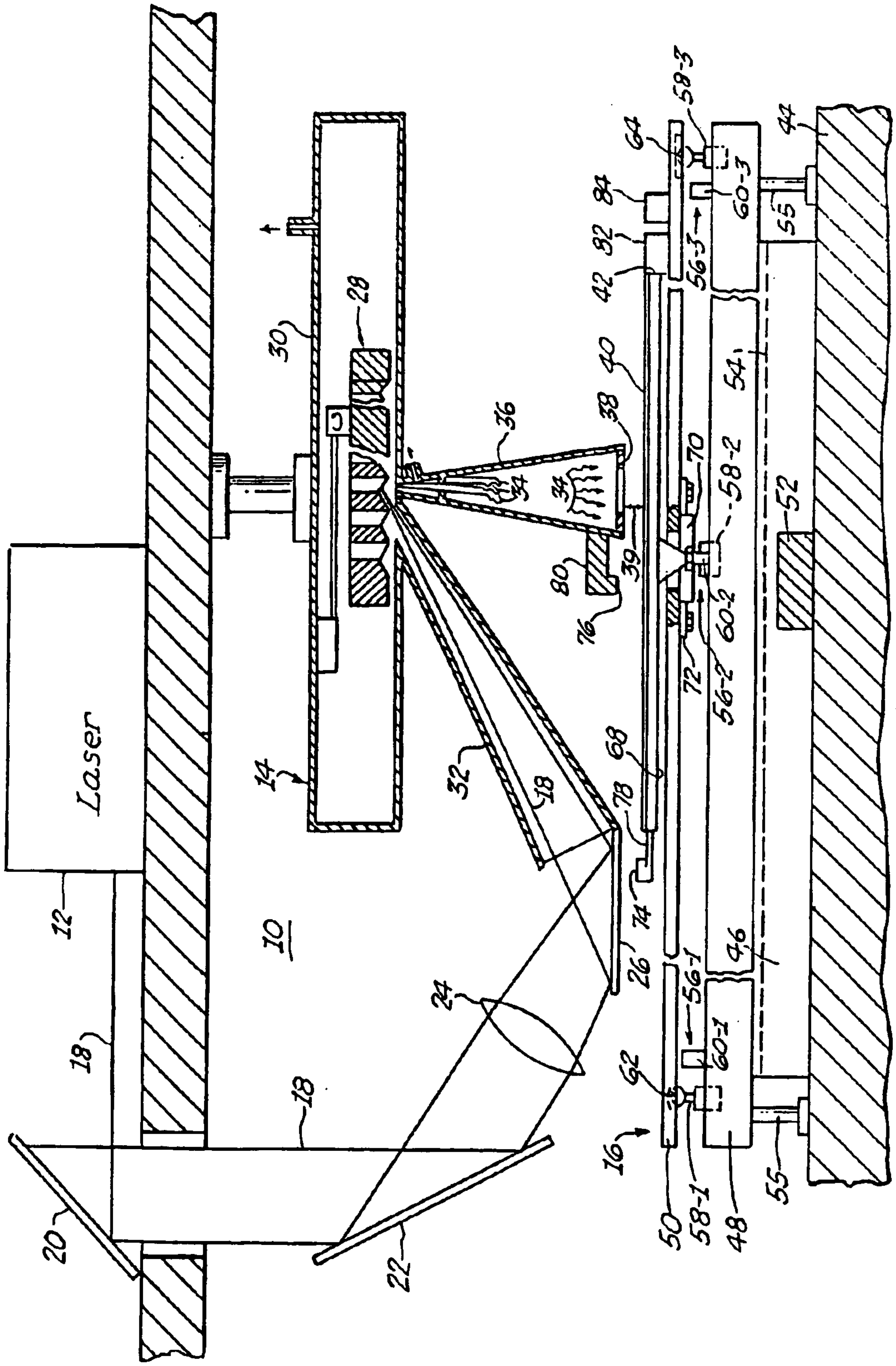
Laser
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Fig.1.

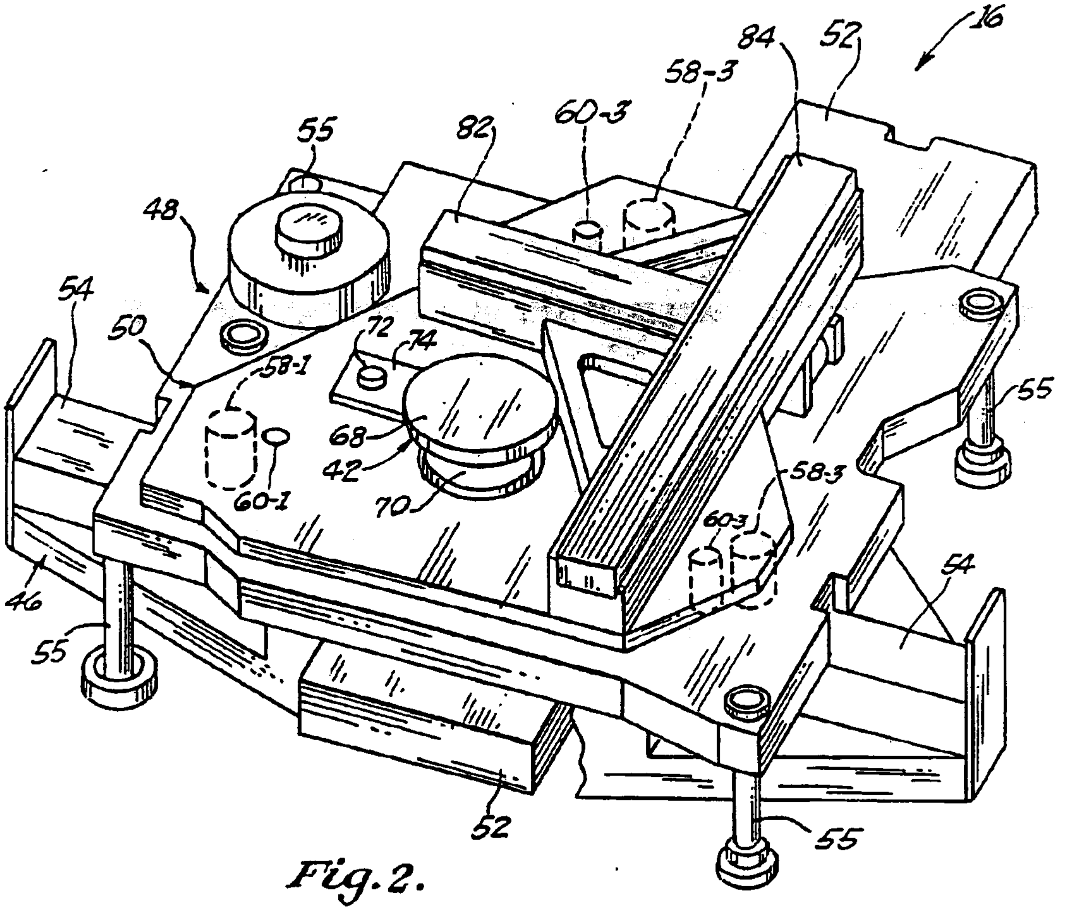


Fig.2.

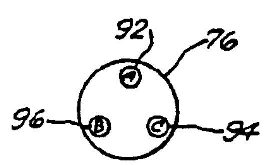


Fig.4.

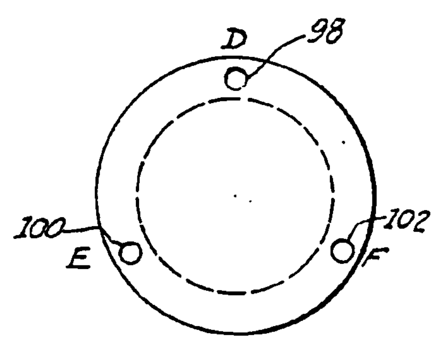


Fig.5.

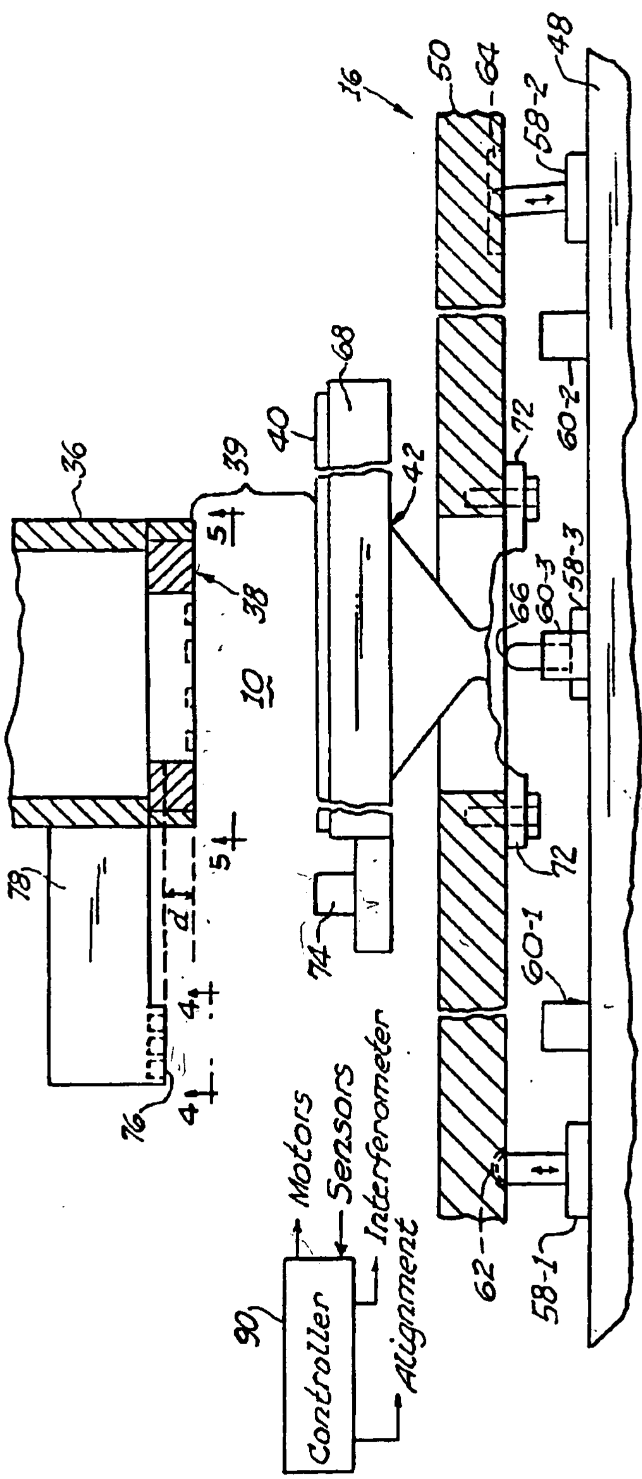


Fig.3.

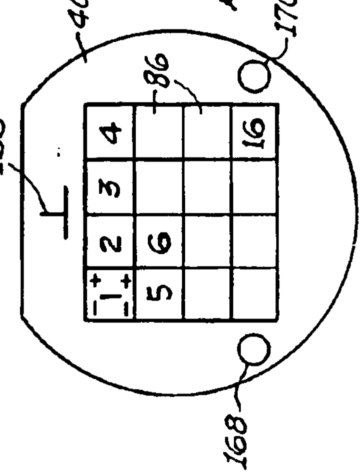


Fig.6.

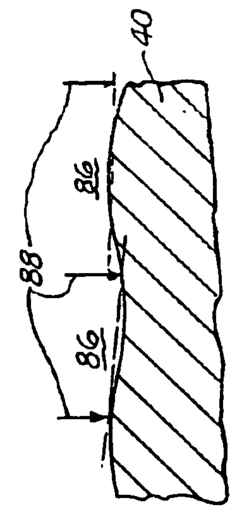
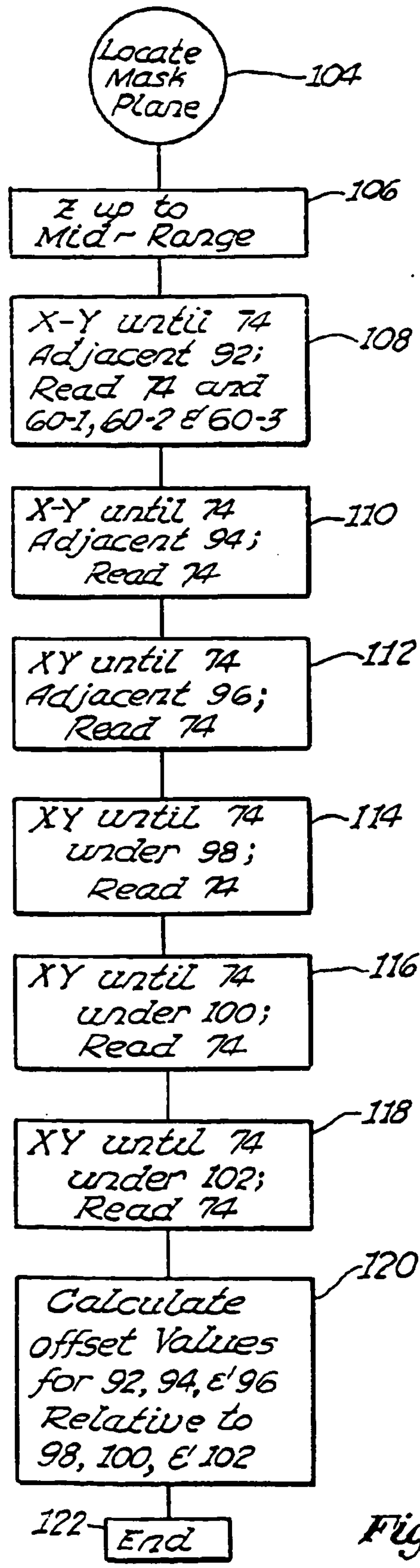


Fig.7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Z up to Mid-Range
106
X-Y until 74 Adjacent 92; Read 74 and 60-1, 60-2 & 60-3
108
X-Y until 74 Adjacent 94; Read 74
110
XY until 74 Adjacent 96; Read 74
112
XY until 74 under 98; Read 74
114
XY until 74 under 100; Read 74
116
XY until 74 under 102; Read 74
118
Calculate offset Values for 92, 94, & 96 Relative to 98, 100, & 102
120
122
End

Fig.8.

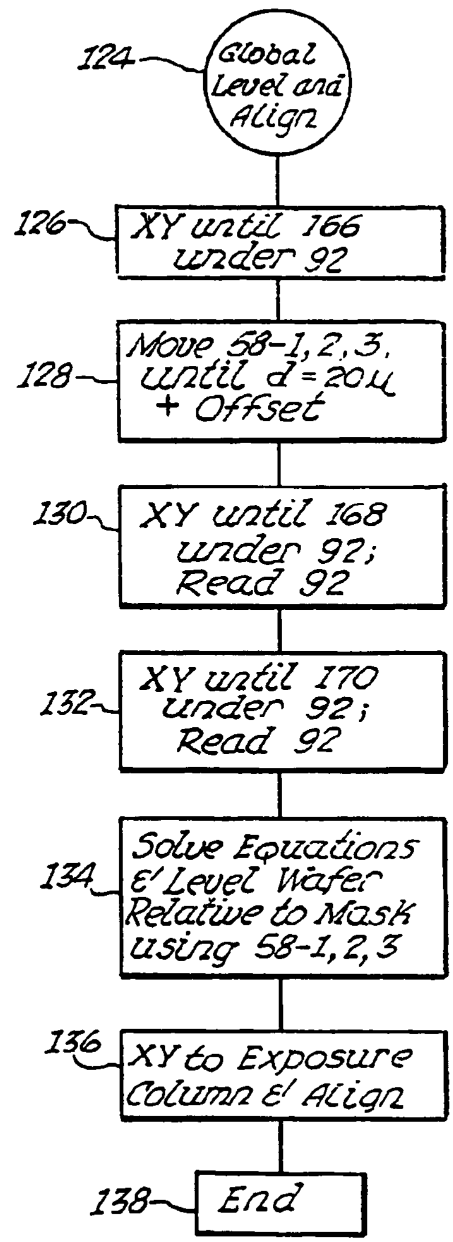
124
Global Level and Align
126
XY until 166 under 92
128
Move 58-1, 2, 3, until d = 20μ + Offset
130
XY until 168 under 92; Read 92
132
XY until 170 under 92; Read 92
134
Solve Equations & Level Wafer Relative to Mask using 58-1, 2, 3
136
XY to Exposure Column & Align
138
End

Fig.9.

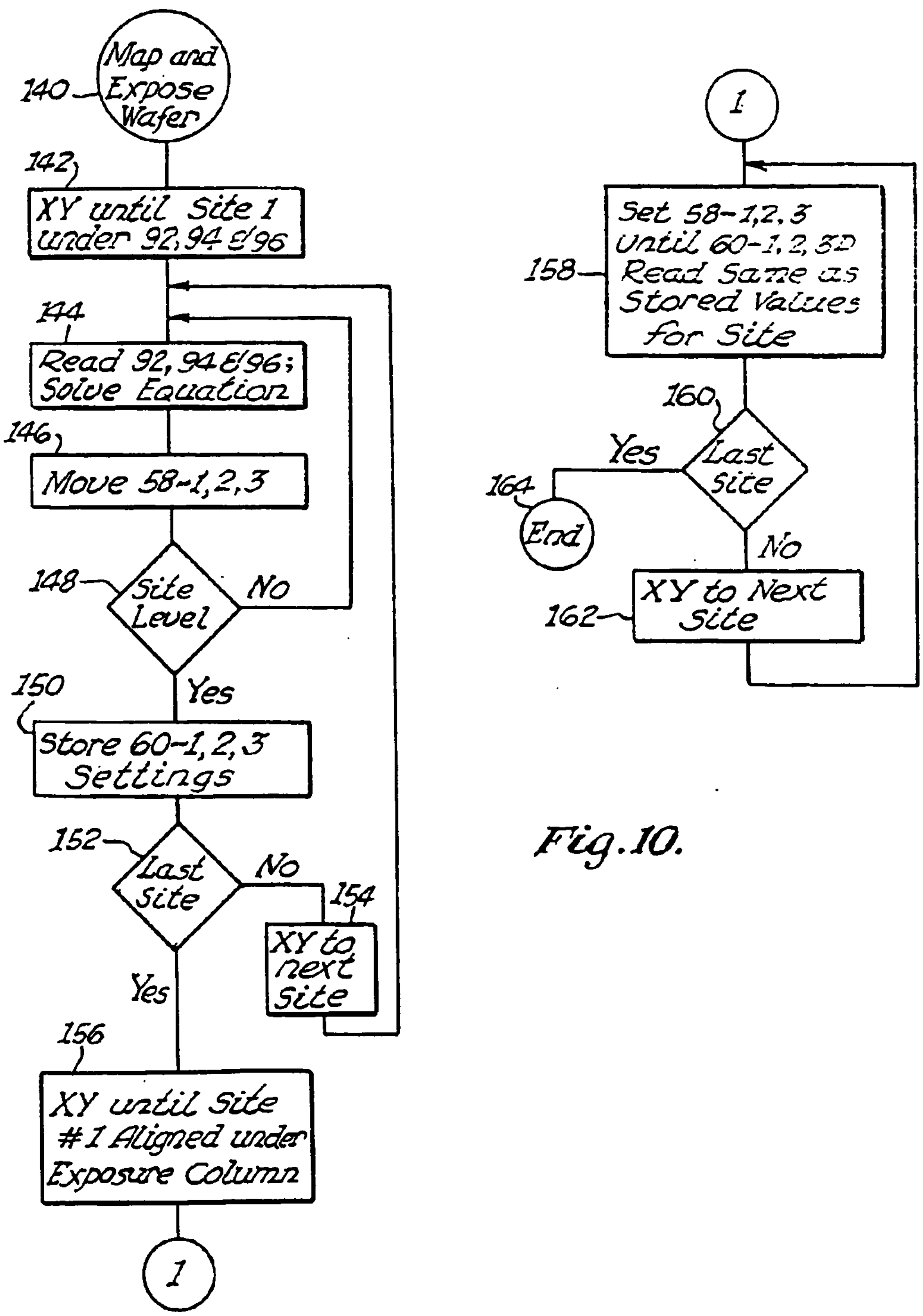
Map and Expose Wafer
140
142
XY until Site 1 under 92,94 &96
144
Read 92,94 &96; Solve Equation
146
Move 58-1,2,3
148
Site Level
No
Yes
150
Store 60-1,2,3 Settings
152
Last Site
No
154
XY to next Site
Yes
156
XY until Site #1 Aligned under Exposure Column
1
1
158
Set 58-1,2,3 Until 60-1,2,3D Read Same as Stored Values for Site
160
Last Site
Yes
164
End
No
162
XY to Next Site

Fig.10.